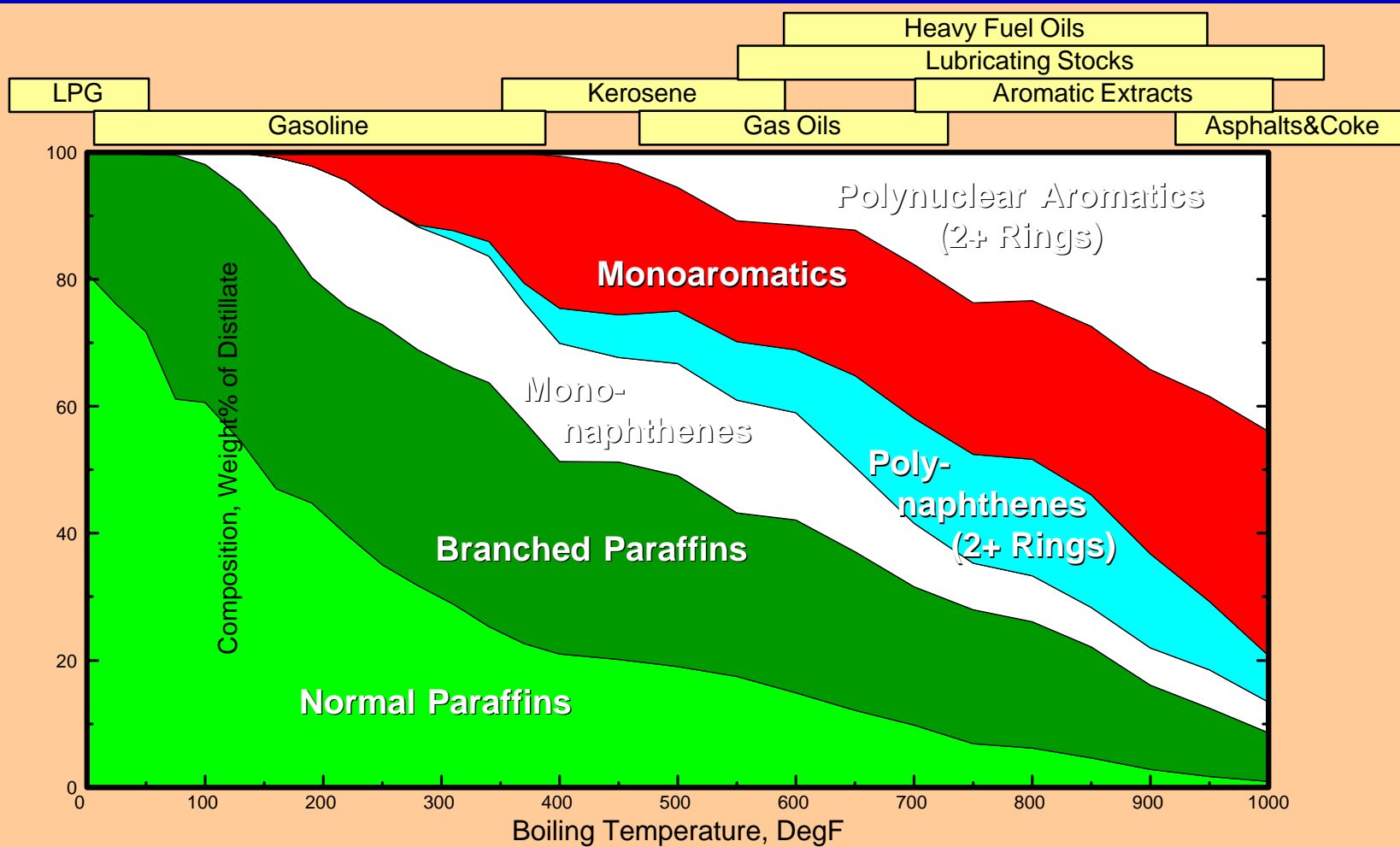

Petroleum Stream Chemistry

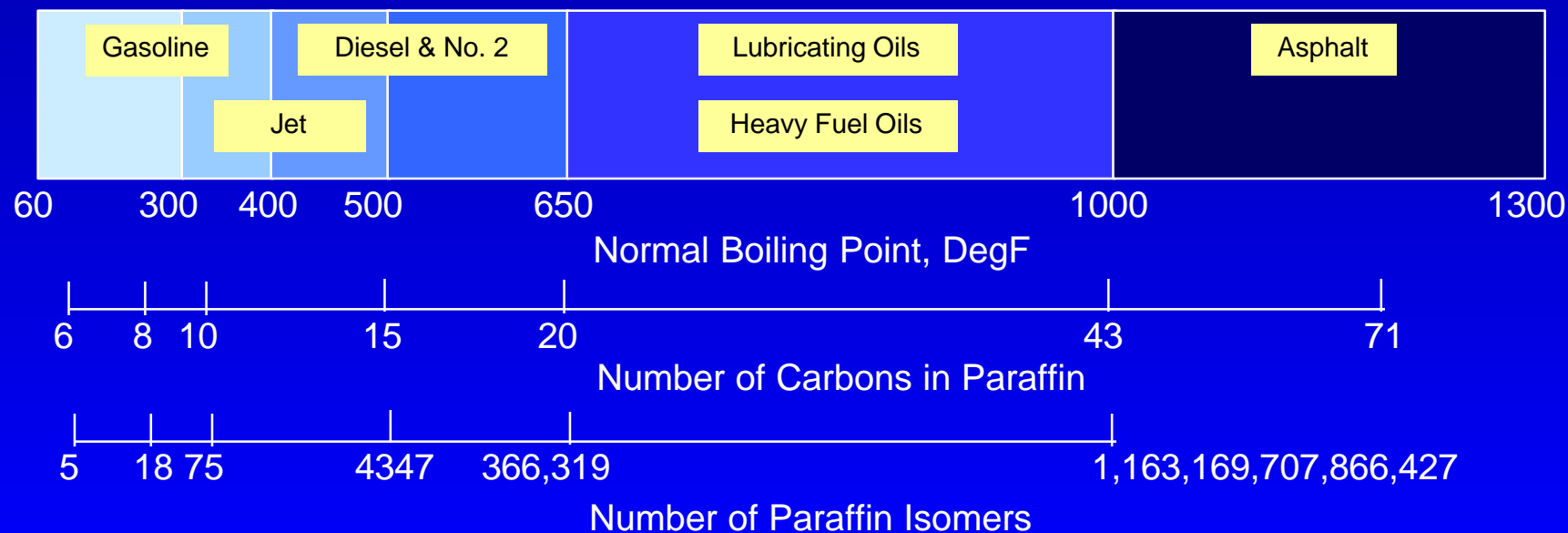
Testing by Product Category

Crude Oil Composition Schematic

Petroleum Hydrocarbon Types for Arabian Heavy Crude



Higher Boiling Products are Chemically More Complex



- More molecular species as boiling point increases
- Concentration of individual molecules becomes smaller

Advantages of API/CONCAWE Category Approach

- Organize 400 streams by physical-chemical composition and by available toxicity data
- Provide optimal utilization of testing resources
 - » Animals
 - » Timing
 - » Laboratory space
- Build on CONCAWE database and allow rapid dissemination of available data to public
- Harmonize U.S. and EU efforts to fill data gaps
-

CONCAWE Dossiers/Products	GroupNo	CONCAWE Group Name
Crude oil	1	Crude Oil (1)
Liquefied petroleum gas	2	Petroleum Gases (2)
Gasolines	3	Gasoline Components from Crude Oil Distillation (3A)
	4	Gasoline Components from Alkylation, Isomerisation and Solvent Extraction (3B)
	5	Gasoline Components from Catalytic Cracking (3C)
	6	Gasoline Components from Catalytic Reforming (3D)
	7	Gasoline Components from Thermal Cracking (3E)
	8	Gasoline Components from Hydrotreating (3F)
	9	Other Gasoline Components (3G)
Kerosines/jet fuel	10	Straight Run Kerosene Components (3H)
	11	Cracked Kerosene Components (3I)
	12	Other Kerosene Components (3J)
Gas oils (diesel fuels/heating oils)	13	Straight Run Gas Oil Components (4A)
	14	Cracked Gas Oil Components (4B)
	15	Hydrocracked Gas Oil Components (New)
	16	Vacuum Gas Oil Components (5A)
	17	Other Gas Oil Components (5B)
	18	Distillate Fuel Oils (New)
Heavy fuel oils	19	Fuel Oil Components (6A)
	20	Lubricating Greases (6B)
Lubricating oil basestocks	21	Unrefined or Acid Treated Vacuum Distillates (7A)
	22	Non-carcinogenic Lubricant Base Oils (7B)
	23	Other Lubricant Base Oils (7C)
Aromatic extracts	24	Residual Aromatic Extracts (8)
	25	Untreated Aromatic Extracts from Vacuum Distillates (9A)
	26	Treated Aromatic Extracts from Vacuum Distillates (9B)
	27	Other Aromatic Extracts (10)
Waxes and related products	28	Petroleum Waxes (11A)
	29	Foots Oils (11B)
	30	Slack Waxes (11C)
	31	Petrolatums (11D)
	32	Used and Re-refined Oils (12)
Bitumens and bitumen derivatives	33	Bitumens (Asphalts) and Vacuum Residues (13)
Petroleum coke	34	Petroleum Cokes (14)
	35	Other Petroleum Gases (New)
	36	Reclaim Petroleum Substances (New)
	37	Other Petroleum Substances (New)

Category Example

Gasoline Refinery Streams

- Building blocks for Gasoline
- ~50 Streams on TSCA represent major processes
 - » Distillation, Alkylation, Cracking, and Reforming
- Stream contribute all chemical classes in gasoline over a wide range of concentrations

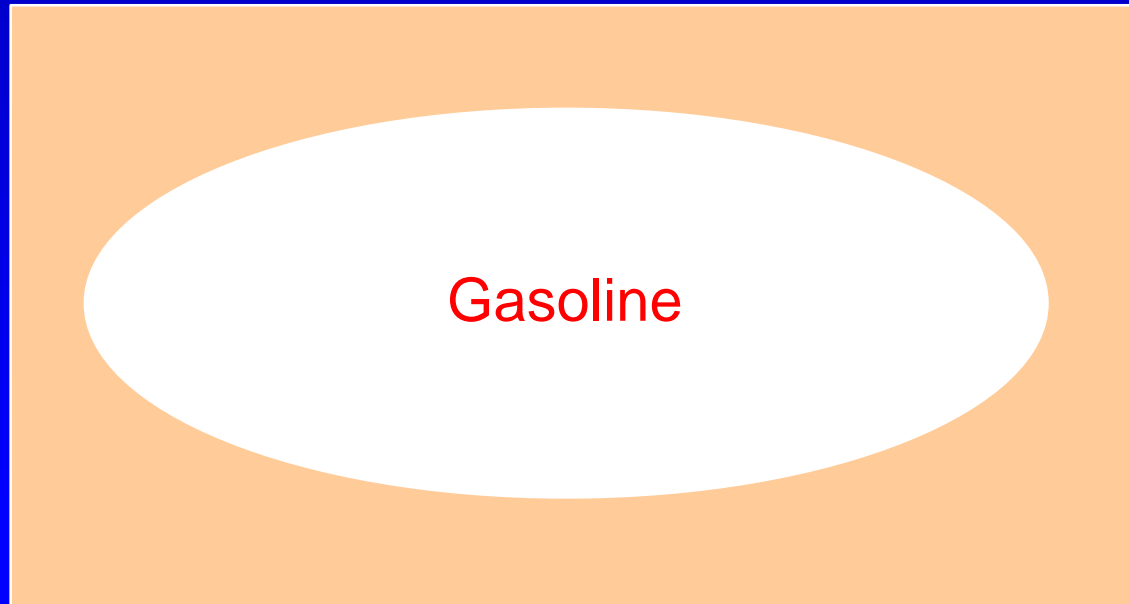
	<u>Int'l Range, Vol%</u>
Paraffins	30 - 90
Olefins	0 - 20
Naphthenes	1 - 35
Aromatics	5 - 55

- Key stakeholders must concur on categories

Category Testing Building the Box

Paraffins

Olefins

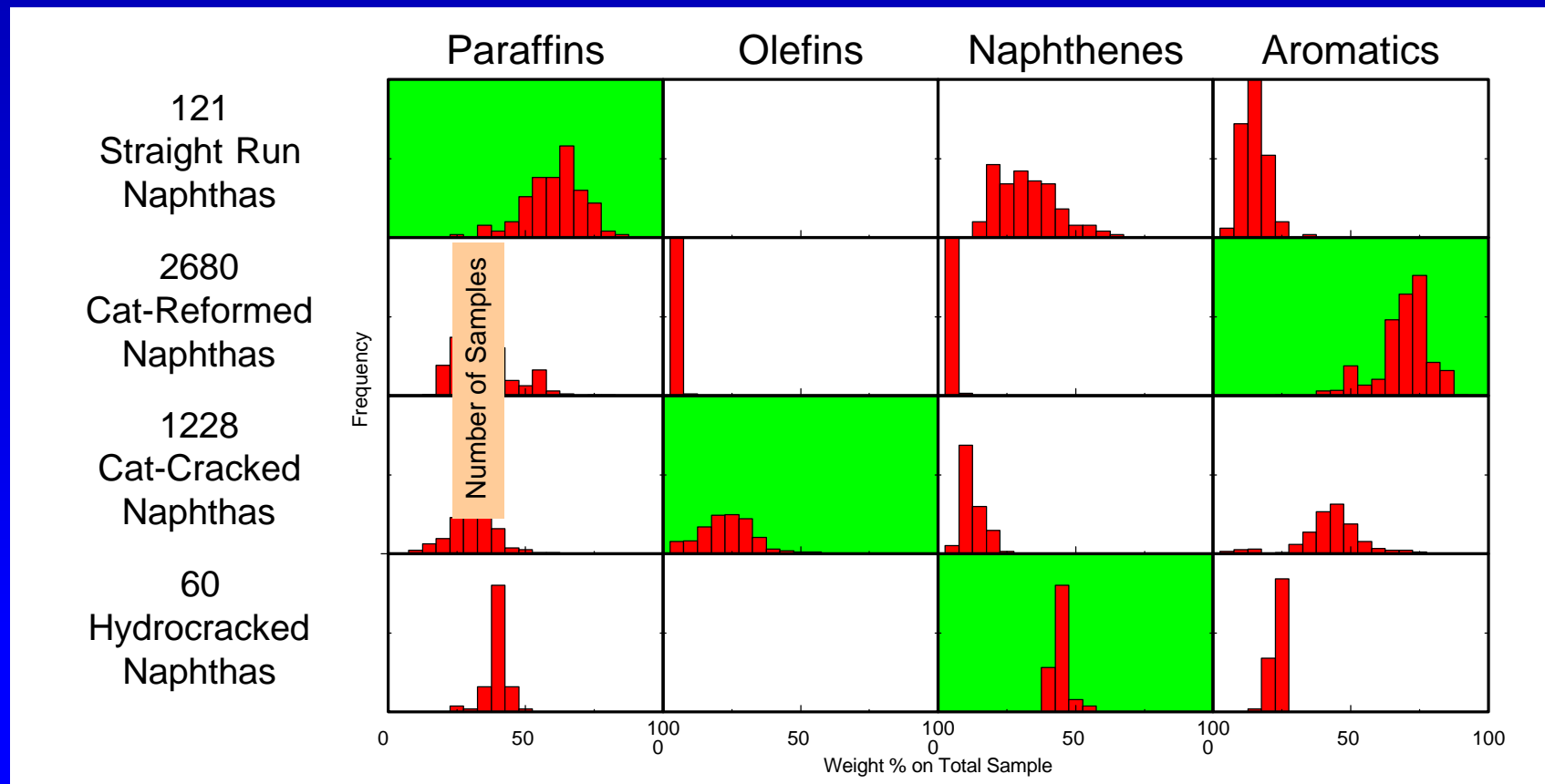


Aromatics

Naphthenes

Gasoline Stream Example

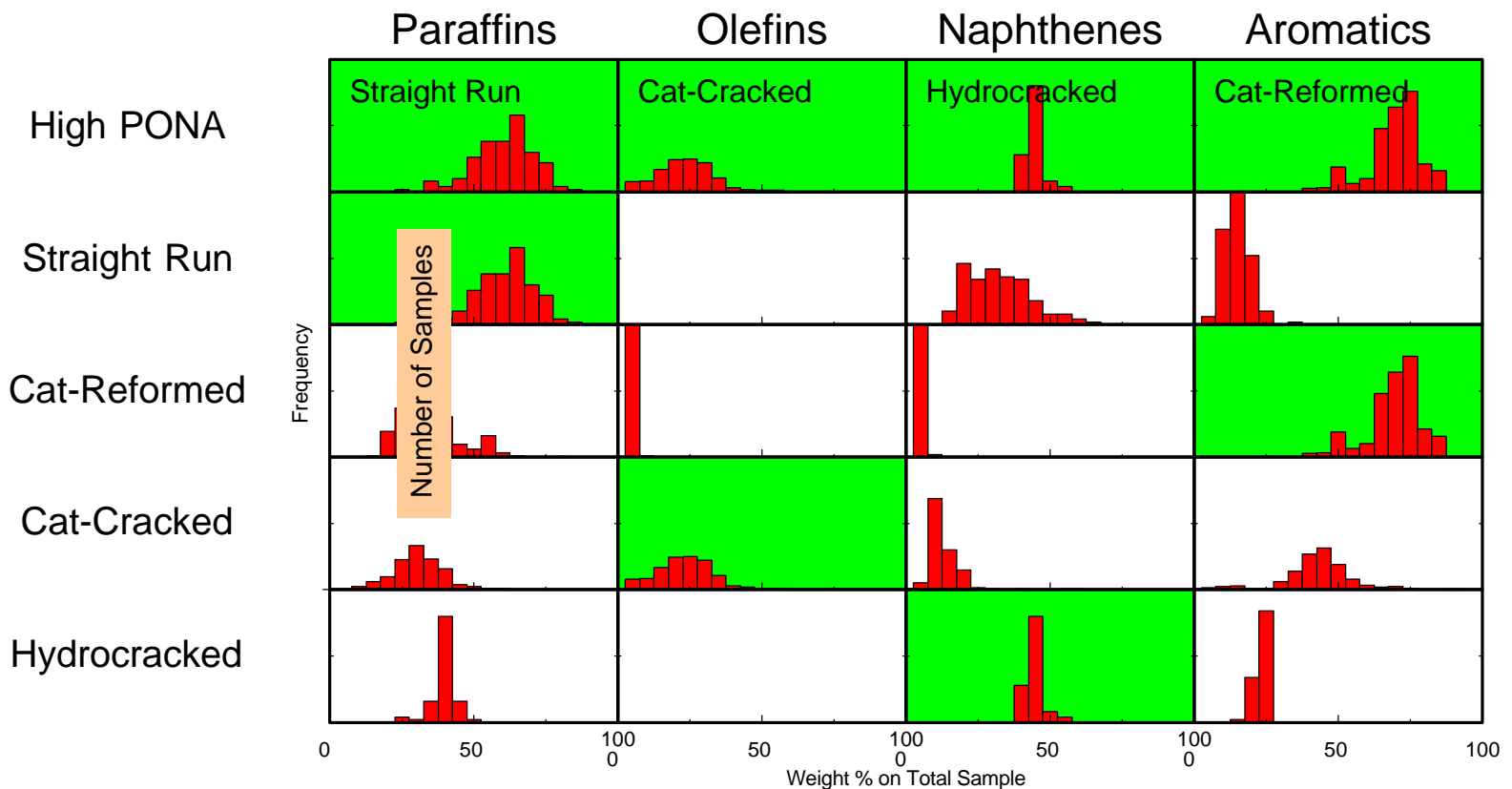
Composition Varies Within and Between Groups



- Samples chosen for testing will include all isomers.

Gasoline Stream Example

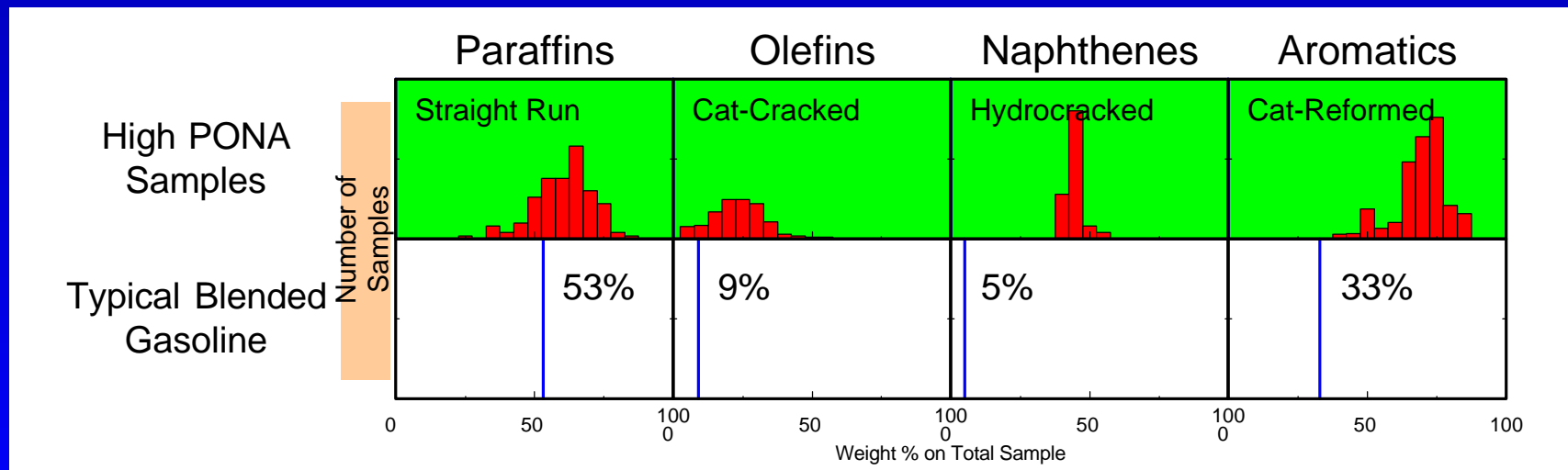
Test Groups with Highest Constituent Concentrations



- Test Groups with extreme compositions to bound composition of other groups and blended Gasolines

Gasoline Stream Example

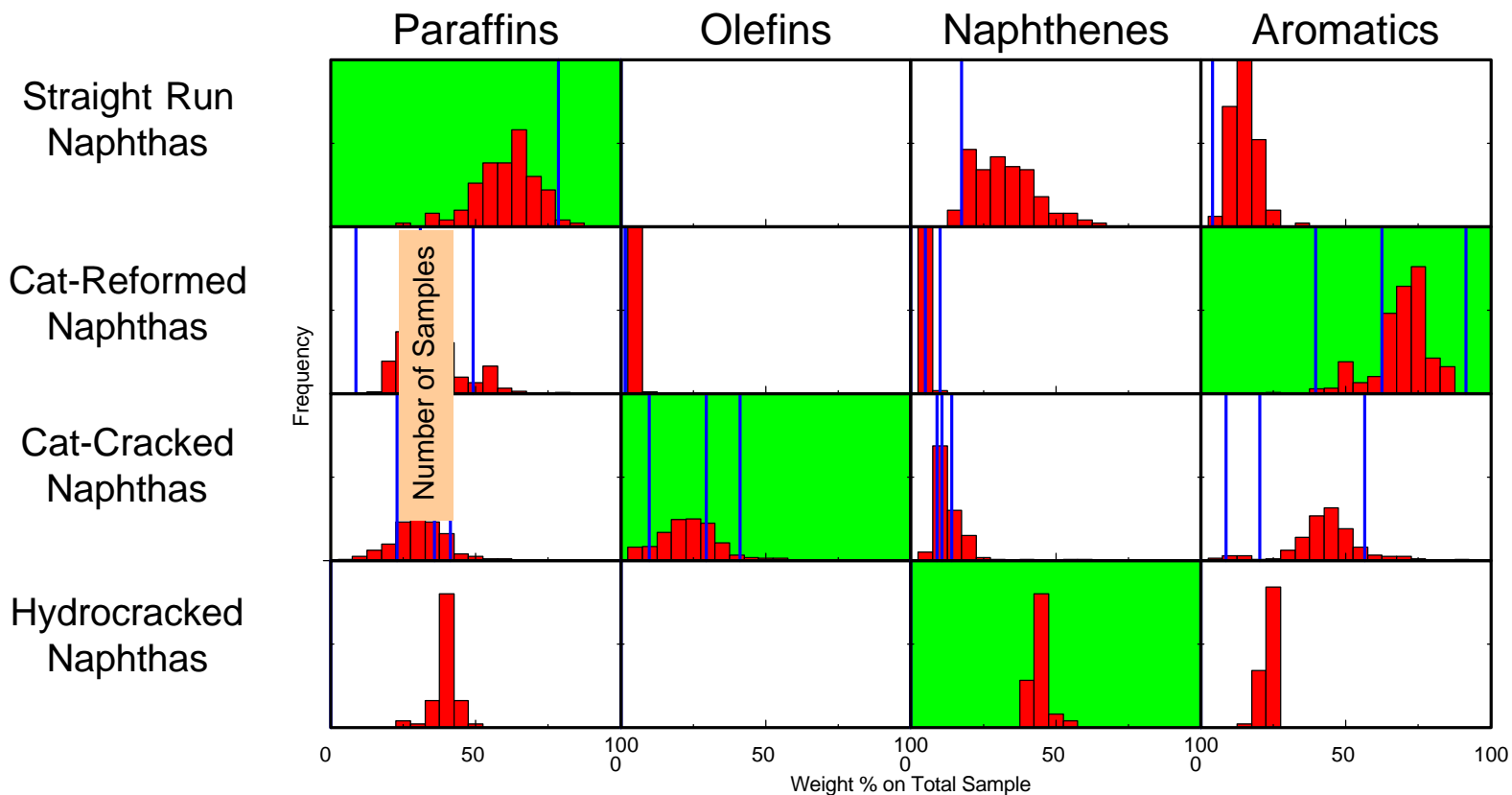
High PONA Samples Bound Blends and Other Groups



- Blended Gasoline samples have lower constituent concentrations than the individual gasoline blending components
- Blue Bars represent composition of typical Blended Gasoline

Gasoline Stream Example

Compositions of Samples Already Tested



- Blue Bars are compositions of samples already tested (for some tests).
- Paraffins, Olefins, and Aromatics are well represented.

Gasoline Substance Groups Availability of Mammalian Toxicological Data

Gasoline Substance Groups

Availability of Environmental Data

Substances	LC ₅₀ Fish	LC ₅₀ Daphnia	EC ₅₀ Algae	LC ₅₀ Shrimp	Daphnia Chronic	Fish Chronic	Biodeg.	Photo-deg.	Hydro-lysis	Distribution	Physical Props.	BOD/COD	Bio-accum.
Straight-Run Naphthas	√	√	√	√	–	–	–	√	√	√	√	–	–
Alkylate Naphthas	√	√	√	√	IP	IP	IP	√	√	√	√	–	–
Cat-Cracked Naphthas	√	√	√	√	IP	IP	IP	√	√	√	√	–	–
Cat-Reformed Naphthas	√	√	√	√	IP	IP	IP	√	√	√	√	√	√
Thermally Cracked Naphthas	–	–	–	–	–	–	–	√	√	√	√	–	–
Hydrotreated Naphthas	–	–	–	√	–	–	–	√	√	√	√	–	–
Gasoline	√	√	√	√	–	–	–	√	√	√	√	–	–

IP - In Progress

Gasoline Stream Example

Conclusions

- Refinery stream and blended Gasoline samples tested to date cover Paraffins, Olefins, and Aromatics well.
- Some intermediate process streams have higher concentrations of Naphthenes than samples tested to date. Appropriate samples will be tested.